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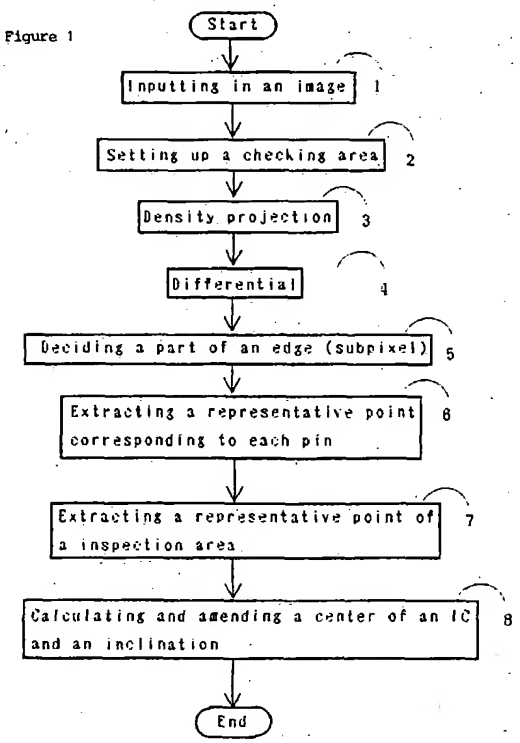
(54) Inspection method of inclination of an IC.

(57) The present invention has a purpose to provide an inspection method of inclination of an IC in order to fix a position of IC speedily and precisely without the image information of binarized images.

An inspection method of inclination of an IC according to this invention defines an inspection area including open ends of IC pins, extracts longitudinal edges and open ends of pin of each IC pin from a density projection of each inspection area, calculates a representative point of each inspection area on a line along the open ends and calculates a center and inclination of an IC according to a difference of coordinates of a representative point of the inspection area positioninig in the opposite side.

Figure 1



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FIELD OF THE INVENTION

The present invention relates to an inspection method of inclination of an IC to fix a position for mounting IC on a board.

BACKGROUND OF THE INVENTION

To amount an IC on the predetermined position on a board, it is necessary to set an exact position of the IC. In order to find exact position of IC, it is necessary to check a center of IC and its angle of the inclination. In the case extracting the center of IC and its angle of the inclination according to an image processing, the extraction is processed according to a binarized image in order to make the processing speed to be high in the most cases. However, the binarized image is easily damaged by a change of degree of brightness of lights, and it has trouble of a precise guarantee in measuring value.

SUMMARY OF THE INVENTION

The present invention solves the above conventional problems, and it has a purpose to provide an inspection method of inclination of an IC in order to fix a position of IC speedily and precisely without the image information of binarized images.

An inspection method of inclination of an IC according to this invention defines a inspection area including open ends of IC pins on each side of IC package, extracts longitudinal edges and open ends of each IC pin from a density projection of each checking area, calculates a representative point of each checking area on a line along the open ends and calculates an inclination of an IC according to a difference of coordinates of a representative point of the checking area positioning on the opposite side.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a flow chart showing an embodiment of the present invention.

Figure 2 is a conceptual diagram showing a setting of a checking area.

Figure 3 is a conceptual diagram showing a point corresponding to a density projection, a primary differential and each pin of a checking area.

Figure 4 is a diagram for explaining a position of an edge of a subpixel unit.

Figure 5 is a conceptual diagram showing a center of an IC.

PREFERRED EMBODIMENT OF THE PRESENT INVENTION

Hereinafter, an embodiment of an inspection method of an inclination of an IC of the present invention is described with reference to the attached drawings. Figure 1 is a flow chart showing an embodiment of the present invention.

First, an image of IC with pins on 4 sides of QFT type etc. is taken on step 1. The value of density of the background and that of pin part have difference.

On step 2, checking ranges are set on the predetermined position in the image of IC and defines each of them as CR1 to CR4 (Figure 2). One checking area is set in each side of IC, and there must be open ends of IC pins.

A density projection of directions of X-axis and Y-axis of a checking area is generated on step 3. Figure 3 shows a density projection of a checking area CR1, which is an example. The density projection is data integrated multi-valued information of gray level of an image. The density projection has highly reliable information comparing with a binarized image lacking information on information compression.

On step 4, primary differential is performed for the density projection generated on step 3. Figure 3 shows the differential result by a thick line. As the result, a line along longitudinal edges of IC pins is emphasized, that is, the part to be emphasized is a boundary part of X-axis direction and a line along the open ends of IC pins, in other words, it is a boundary part of Y-axis direction (A boundary point is expressed by an "edge" hereafter.).

On step 5, a position of an edge is extracted by a subpixel unit, where a coordinate exists between subpixels. Figure 4 shows a part of the edge by a pixel unit of an image in a direction of Y-axis. It is usual that there are uneven in an image as Figure 4. In order to calculate more accurate position of the edge, that is Y-coordinates from such an image data, subpixels must be considered. As a result, it is possible to obtain a more exact and precise Y-coordinates (Figure 6 shows a line of X-axis of the coordinates.) than the method obtaining coordinates by a pixel unit with the maximum value of a primary differential. The coordinates of a direction of X-axis is also calculated by a subpixel unit.

In order to extract a part of an edge, the predetermined value calculated in experience is set as a threshold value, and a part is defined as an edge in the case the primary differential value is over the threshold value. In order to unify a setting method of threshold value, it is better to perform normarization after primary differential.

On step 6, a point corresponding to each IC pin is extracted. The point is represented by a

cross point of a broken line showing a central point of a position of longitudinal edges of each pin and a thick line showing a position of an open edge of each pin as in Figure 3. The cross points are defined by P1 to Pn in the figure.

On step 7 in Figure 3, a mean of a X-coordinates of points from P1 to Pn corresponding to each pin is calculated on X-axis, and it is defined as a representative point RP1 of a checking area CR1.

Each representative point is calculated in all checking areas as above. They are shown by RP1 to RP4 in Figure 5.

Next, on step 8 as shown in Figure 5, lines connecting representative points positioning in the opposite side are calculated and defined as L1 and L2. Then, a crossing point of the lines is defined as a central point of the IC. An inclined angle can be calculated according to $\Delta Y/\Delta X$ when a difference of X-coordinates of RP1 and RP3 is defined as ΔX and a difference of a Y-coordinates of RP2 and RP4 is defined as ΔY.

It is possible to calculate an inclined angle in high speed by the present invention because the checking area is small on the predetermined position and the necessary time for the processings is short.

The IC is rotated by the inclined angle defining the calculated center of IC as the center of it and its inclination is amended.

The present invention mentioned above can exactly extract the inclination of an IC precisely in high speed without the information of binarized image, and amend the inclination after the extraction easily.

Claims

1. An inspection method of inclination of an IC for aligning sides of said IC substantially in parallel to X-axis and Y-axis comprising steps of:
   i) inputting an image of an IC;
   ii) defining a plurality of inspection areas including open ends of a plurality of IC pins at the predetermined positions in said image;
   iii) generating a density projection in each inspection area;
   iv) defining taht a position where a primary differential of the density projection exceeds a predetermined value is longitudinal edges and open ends of said IC pins;
   v) defining a representative point at a predetermined position of said inspection area according to a position of said open ends; and
   vi) calculating inclination of an IC according to the difference of coordinates of the representative point of said inspection areas on the opposite side;

2. An inspection method of inclination of an IC as claimed in Claim 1, wherein said representative point is given by the mean coordinate of midpoints of a width of each IC pin.

3. An inspection method of inclination of an IC as claimed in Claim 1, wherein coordinates of said longitudinal edges and open ends are calculated so that coordinate between pixels can be defined.

Figure 1

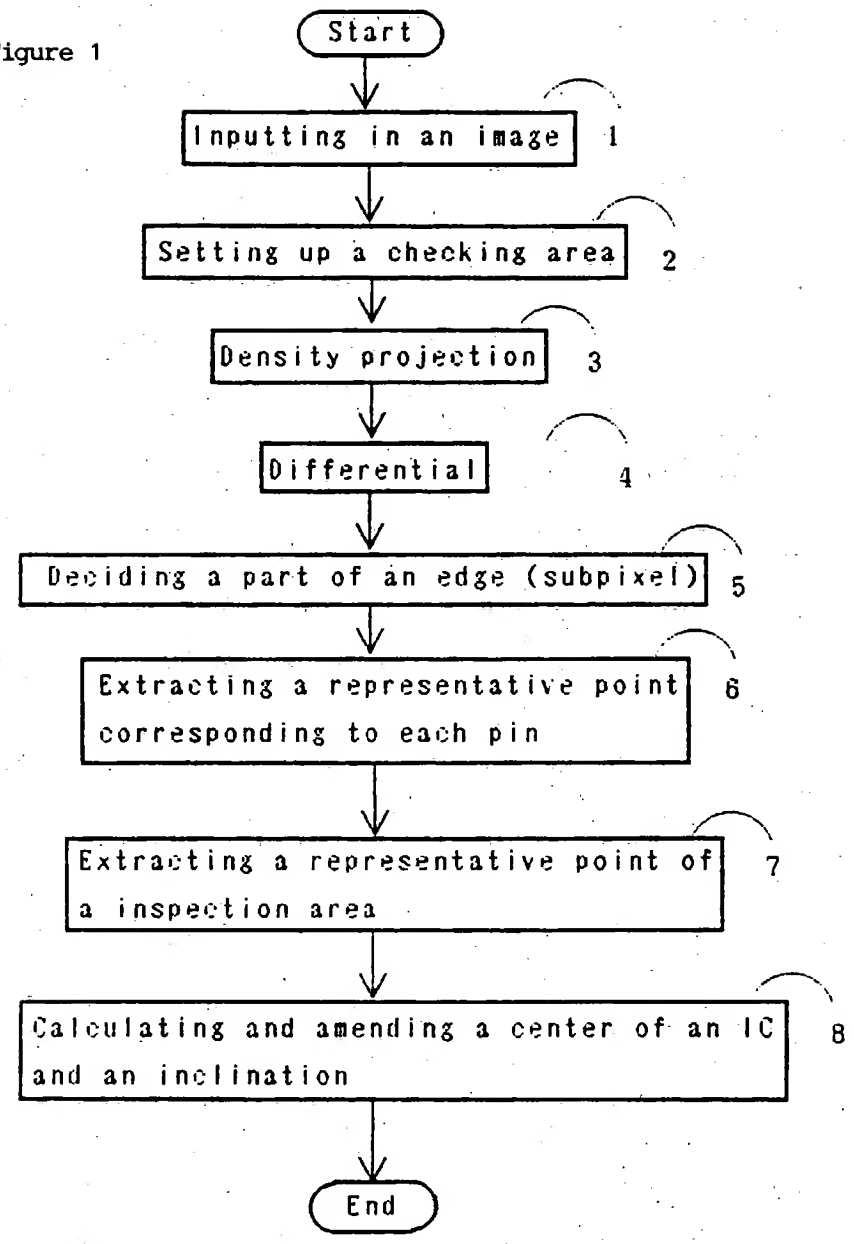

Start
Inputting in an image
1
Setting up a checking area
2
Density projection
3
Differential
4
Deciding a part of an edge (subpixel)
5
Extracting a representative point corresponding to each pin
6
Extracting a representative point of a inspection area
7
Calculating and amending a center of an IC and an inclination
8
End

Figure 2

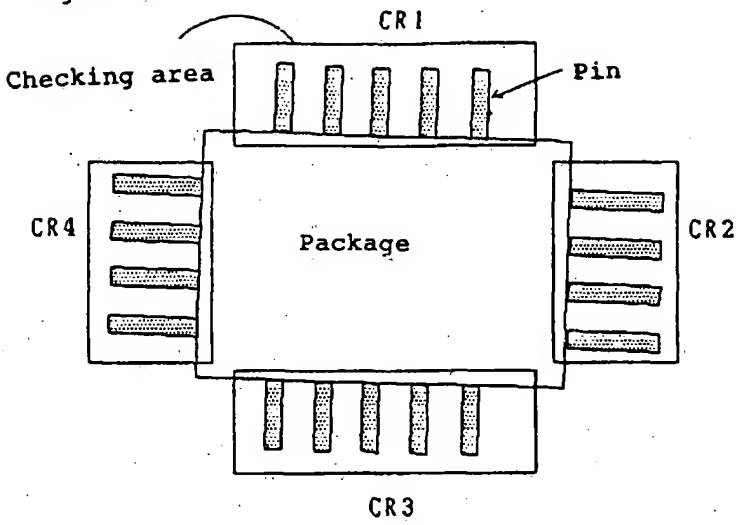


Figure 3

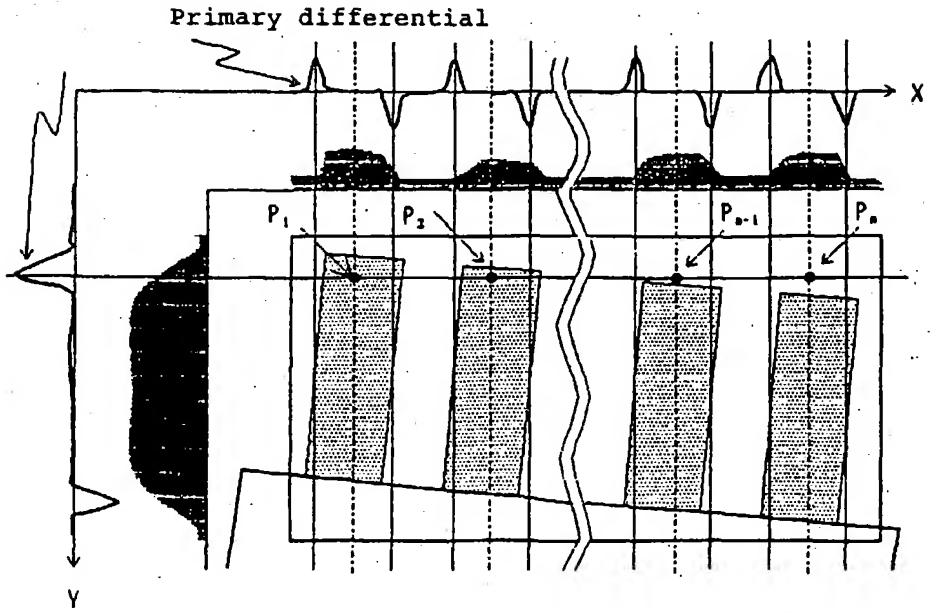


Figure 4

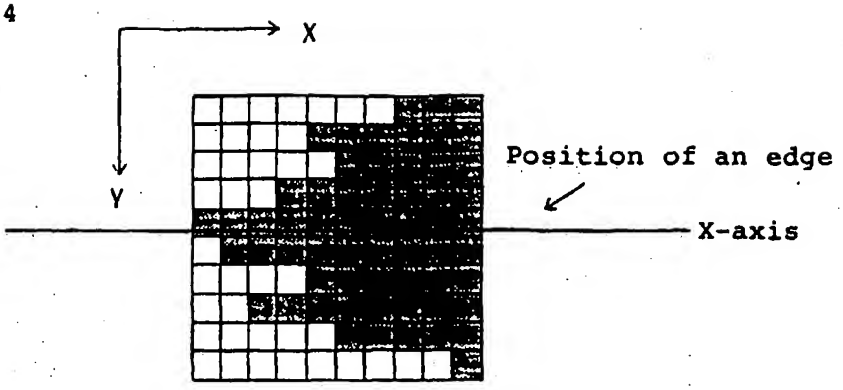
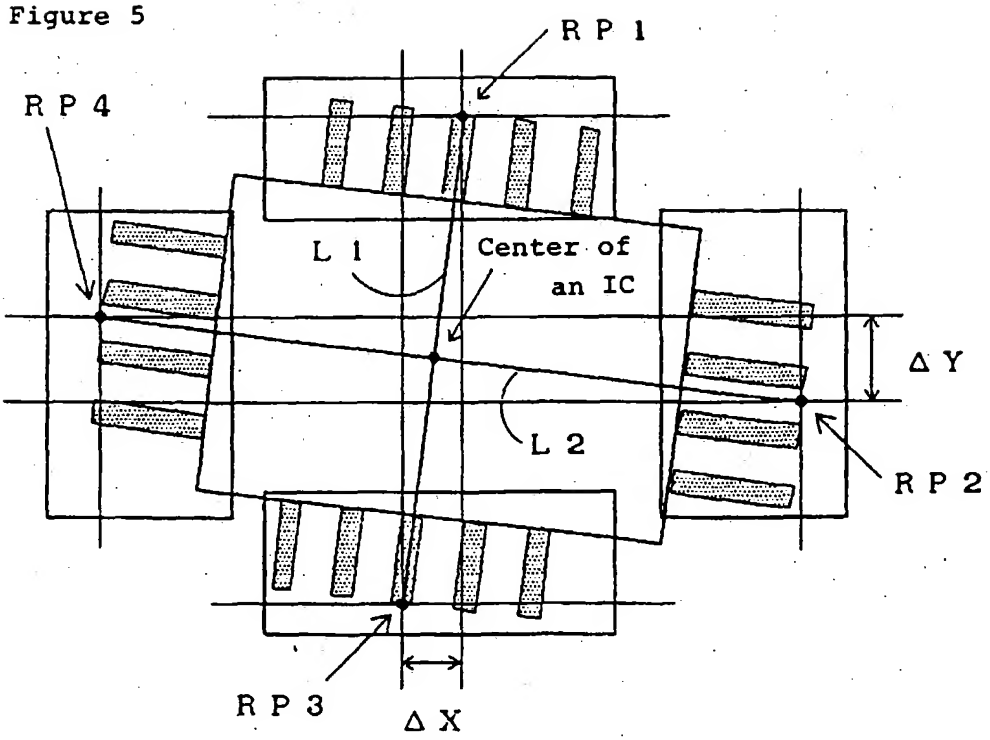


Figure 5



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EUROPEAN SEARCH REPORT

Application Number
EP 93 11 0372

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 222 072 (HITACHI LTD.) * page 6, line 10 - page 8, line 8; figures 7-10 *	1-3	H05K13/08 H01L21/00
A	EP-A-0 374 848 (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.) * page 4, line 48 - page 5, line 55; figure 3 *	1	
A	EP-A-0 062 335 (HITACHI LTD.) * page 14, line 2 - page 15, line 11; figures 2-4 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H05K
H01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05 OCTOBER 1993	BOLDER G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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